CBUSH Generalized Spring-and-Damper Connection

Defines a generalized spring-and-damper structural element that may be nonlinear or frequency dependent.

Format:

1	2	3	4	5	6	7	8	9	10
CBUSH	EID	PID	GA	GB	GO/X1	X2	X3	CID	
	S	OCID	S1	S2	S3				

Example 1: Noncoincident grid points.

CBUSH	39	6	1	100	75				

Example 2: GB not specified.

CBUSH	39	6	1					0	

Example 3: Coincident grid points (GA ≠ GB).

CBUSH	39	6	1					6	

Example 4: Noncoincident grid points with fields 6 through 9 blank and a spring-damper offset.

CBUSH	39	6	1	600					
	0.25	10	0.	10.	10.				

Describer	Meaning
EID	Element identification number. (0 < Integer < 100,000,000)
PID	Property identification number of a PBUSH entry. (Integer > 0; Default = EID)
GA, GB	Grid point identification number of connection points. See Remark 6. (GA > 0, GB ≥ 0 or blank)
Xi	Components of orientation vector $\vec{v}$, from GA, in the displacement coordinate system at GA. (Real)
GO	Alternate method to supply vector $\vec{v}$ using grid point GO. Direction of $\vec{v}$ is from GA to GO. $\vec{v}$ is then transferred to End A. See Remark 3. (Integer > 0)
CID	Element coordinate system identification. A 0 value means the basic coordinate system will be used. If CID is blank, then the element coordinate system is determined from GO or Xi. See Figure 9-22 and Remark 3. (Integer ≥ 0 or blank)
S	Location of spring damper. See Figure 9-21. (Real; Default = 0.5)

Describer	Meaning
OCID	Coordinate system identification of spring-damper offset. See Remark 9. (Integer ≥ -1; Default = -1, which means the offset point lies on the line between GA and GB according to Figure 9-22)
S1, S2, S3	Components of spring-damper offset in the OCID coordinate system if OCID ≥ 0. See Figure 9-23 and Remark 9. (Real)

Remarks:

1. Element identification numbers should be unique with respect to all other element identification numbers.
2. Figure 9-22 shows the bush element geometry.
3. CID ≥ 0 overrides GO and Xi. Then the element x-axis is along T1, the element y-axis is along T2, and the element z-axis is along T3 of the CID coordinate system. If the CID refers to a cylindrical coordinate system or a spherical coordinate system, then grid GA is used to locate the system. If for cylindrical or spherical coordinate, GA falls on the z-axis used to define them, it is recommended that another CID be selected to define the element x-axis. Nastran does not convect user specified coordinate systems, thus with this option, in nonlinear analysis the element stiffness direction does not change with deformation.
4. For noncoincident grids (GA ≠ GB), when GO or (X1, X2, X3) is given and no CID is specified, the line AB is the element x-axis and the orientation vector $\vec{v}$ lies in the x-y plane (similar to the CBEAM element).
5. For noncoincident grids (GA ≠ GB), if neither GO or (X1, X2, X3) is specified and no CID is specified, then the line AB is the element x-axis. This option is valid only when K1 (or B1) or K4 (or B4) or both on the PBUSH entry are specified (but K2, K3, K5, K6 or B2, B3, B5, B6 are not specified). If K2, K3, K5, or K6 (or B2, B3, B5, or B6) are specified, a fatal message will be issued.
6. If the distance between GA and GB is less than .0001, or if GB is blank, then CID must be specified. GB blank implies that B is a grounded terminal, a gounded terminal is a point with a displacement that is constrained to zero.
7. If PID references a PBUSHT entry, then the CBUSH element may only be defined in the residual structure and cannot be attached to any omitted degrees-of-freedom.
8. Element impedance output is computed in the CID coordinate system. The impedances in this system are uncoupled.
9. If OCID = -1 or blank (default) then S is used and S1, S2, S3 are ignored. If OCID ≥ 0, then S is ignored and S1, S2, S3 are used.

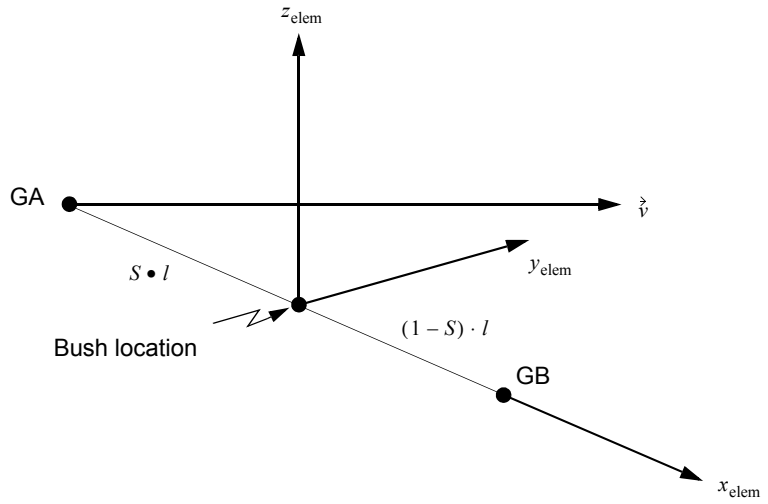
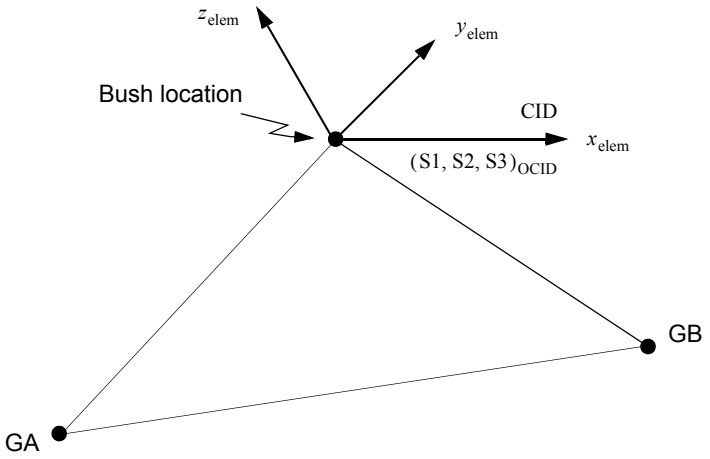


Figure 9-22 CBUSH Element



The material stiffness and damping properties of the elastomer are located at (S1, S2, S3).

Figure 9-23 Definition of Offset S1, S2, S3

10. When CID $\geq$ 0, the element x-axis is set as in Remark 3. This means that the element force is always computed as $Ke \cdot (UB - UA)$; if $UA > UB$, a compressive force will result. This is unlike the GO or Xi options, where relative positive elongation in tension and relative negative elongation is compression.
11. The CBUSH element is designed to satisfy rigid body equilibrium requirements. For noncoincident grids, internal rigid links connect the bush location to the grid locations. This results in coupling between translational and rotational degrees-of-freedom at the grids even when no rotational springs or dampers are specified on the PBUSH.

12. For SOL 600, if G0, X1, X2, X3, CID or OCID are entered, a Severe Warning will be issued and Marc will not run. SOL 600 translates the spring and damping terms in global coordinates of GA and GB and will use K1 to K6 and B1 to B6 whether or not GA and GB are coincident or not. S, S1, S2, S3 are ignored. CID is ignored unless it is zero, in which case K1 and B1 are along the axis of GA to GB and K2-K6 and B2-B6 are ignored if entered.
13. CBUSH elements are not supported in thermal analysis.